ALLEGHENY NATIONAL FOREST GYPSY MOTH SPRAY PROJECT-1989

FINAL REPORT

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Summary

During the period from May 24 to June 8, 1989, approximately 29,885 acres of susceptible forestland were treated to prevent defoliation and reduce nuisance levels from a continuing outbreak of gypsy moth on the Allegheny National Forest.

Three different formulations of Bacillus thuringiensis (B.t.), Dipel 8AF, Foray, and Dipel 8L were applied at a rate of 16 BIU (billion international units) in 1 gallon (128 ounces) of total formulation per acre. The Dipel 8L formulation also had a 2% addition of "Bond" spreader/sticker to help it adhere to the leaf surface. Each of 17,444 acres were treated once while 12,324 of those same acres were treated a second time 5-7 days later in order to reduce gypsy moth populations where they were the greatest threat to forest resources.

Dimilin 25W was applied to 12,441 acres at a rate of 2 oz. of wettable powder in one gallon of water per acre with no additives. Because of the flexibility in the timing of the Dimilin application as opposed to B.t., most of the area treated with Dimilin was treated before 30% average leaf expansion and when most of the larvae were still first instar.

Project results- The objective of preventing moderate defoliation was achieved in all 88 spray blocks, while the objective to reduce egg mass densities by at least 90 percent was achieved in 83 of the 88 blocks. This high degree of success is probably due, in part, to the natural decline of the gypsy moth population as a whole on the Allegheny National Forest and the cold wet spring and early summer experienced in 1989.

Future trends- Gypsy moth populations have declined to levels below those necessary for moderate to severe defoliation to occur throughout all of the Allegheny National Forest. Consequently, no spray project is planned for 1990, however, FPM personnel will continue to monitor gypsy moth populations on a yearly basis to determine when populations again reach spray threshold densities. FPM is also in the process of working with ANF personnel to put together a long range gypsy moth management plan to make use of things that were learned during the first outbreak so that we will be better prepared when the next outbreak occurs.

INTRODUCTION

The gypsy moth, Lymantria dispar L., first reached epidemic populations in the southern portion of the Allegheny National Forest in 1984, and has since progressed north and west to cover the entire forest. In 1985, around 10,500 acres of high value recreation and timber forests were treated, 1,500 acres with Bacillus thuringiensis (Bt, under the trade name of Dipel 8L) and 9,000 acres with diflubenzuron (under the trade name Dimilin 25W). No spraying was done in 1986. In 1987, 29,507 acres were treated with Bt. In 1988, 6,117 acres were treated once while 1,778 acres were given two treatments of B.t..

The 1989 project required spraying B.t. on 17,444 acres with 12,324 acres of this receiving a second application 5-7 days later. Also 12,441 acres were treated with dimilin for a grand total of 42,209 acres sprayed. The suppression project was jointly conducted by R-9, Allegheny National Forest and NA, Forest Pest Management personnel.

INTENT AND SCOPE

This report presents: 1) project objectives; 2) organization and responsibilities of key Forest Service and contract personnel; 3) operational considerations; 4) project safety; 5) project progress, accident/incident reporting; 6) monitoring during spraying; 7) project results; 8) detailed financial statements and budgetary requirements; and 9) spray block location information. The latter item forms the Appendix.

OBJECTIVES

Through the effective and safe aerial application of Dipel 8AF, Dipel 8L, Foray and Dimilin, the Forest Service intended to prevent gypsy moth defoliation of forest trees from reaching the moderate (30-60%) defoliation class within treated areas. A second objective was to reduce egg mass densities by at least 90% in treated areas. Achievement of the Objectives was assessed through the use of ground estimates within and adjoining spray blocks and aerial photography and sketchmap surveys. Gypsy moth population changes were assessed through egg mass counts before and after spraying both in sprayed and unsprayed areas.

ORGANIZATION AND RESPONSIBILITIES

The project organization for Forest Service and Contractor personnel is shown in the following hierarchical outline:

Allegheny National Forest Supervisor	David J. Wright
I.C.O.	Don Clymer
P.I.O.	Wendell Wallace

Spray Timing and Area Marking Personnel

Project Entomologist	Kelly Riddle
Field Activities Coordinators	Kelly Riddle & Mary Knott
	Field Crews
Insect/Foliage Development	4 FPM Personnel
Spray Area Marking & Monitoring Field Crews	8 FPM & 6 ANF & 2 R-9 detailers

Spray Applications Personnel

Air Operations Advisor	Bob Acciavatti
Chase Plane Pilot (contract with USFS approved aircraft)	
Project Safety Specialist	Dan Zimmerman
Project Weather Specialist	Carl Jablonowski
Project Dispatcher	Marienville R.D.

Water Monitoring Personnel

Water Quality and Macroinvertebrate Monitoring	Jack Hill, Brad Nelson, and Scott Reitz

Spray Mixing and Loading Personnel

Contract Inspectors	Bob McBride & Dave Cotterman
Contractor, Pilots	K&K Aircraft Inc.

The Forest Service personnel functioned in the following capacities to coordinate and direct the spray operations. One individual operated in more than one of the the following capacities:

I.C.O. (COR) - Don Clymer: Responsible for overall management of the project. Facilitated daily operations meetings and approved operations action plans. Revised and refined organization or position duties as necessary. Represented the Contracting Officer in contract administration and settling minor contractual matters. Responsible for inspection of project operations to insure contract compliance.

P.I.O. - Wendell Wallace: Developed and maintained accurate and complete information on project progress, current status, resources committed, and other matters of general interest. Served as primary communication link between ANF and gypsy moth organization. Developed and distributed daily situation reports to ANF offices and progess reports to FPM.

Safety Officer - Dan Zimmerman: Developed and distributed project safety plan. Provided safety training to field crews. Accomplished military and civilian aircraft notices. Assessed hazardous and unsafe conditions and developed measures for assuring personnel safety. Had emergency authority to stop and/or prevent unsafe acts. Provided safety message for daily situation reports.

Plans Chief - Bob Acciavatti: Responsible for FPM field activities prior to and after spray activities, and writing of project work plan and annual evaluation report. Supervised calibration prior to spraying, and assisted in scheduling of spray blocks during spraying.

Weather Specialist - Carl Jablonowski: Compiled NOAA weather service short and long term weather forcasts. Provided weather forcast writeup for daily situation report.

Water Monitoring - Jack Hill & Brad Nelson: Deveoloped Dimilin water monitoring plan, obtained water monitoring samples, and wrote monitoring report.

Entomologist - Kelly Riddle: Supervised FPM field crews before, during, and after spraying. Provided technical expertise for conducting surveys and obtained information for scheduling spray blocks. Wrote project plan and annual evaluation report.

Operations Chief - Joe Hepinger: Responsible for direct management of spraying activities. Assisted in scheduling of spray blocks and formulation of the daily action plan. Provided input to daily situation report. Obtained and released necessary resources.

Deputy Operations Chief - Stan Kobielski: Assisted Ops Chief, taking over when Ops Chief needed a break, or when split shifts reduced long hours. Served as Ops Chief when spraying on Bradford District.

Aerial Observers - Bob Acciavatti, Roxane Smith, Dave Cotterman, and Dave Miller: Observed spray operations from the air, checked on accuracy of spray aircraft, kept ops chief informed on completion of spray blocks, and location and activities of spray aircraft.

Dispatcher - Marj Raught: Monitored and logged radio and telephone communications at the command post at Marienville Ranger Station. Assisted PIO in developing and distributing daily situation reports.

Field Coordinators - Kelly Riddle & Mary Knott: Supervised field crews sampling insect development and tree foilage development, deploying balloons for spray block marking, ground checking for spray efficacy, and obtaining spray block weather data.

Inspectors - Bob McBride & Dave Cotterman: Kept records at the airport on hours flown and insecticide loaded, monitored the contractors' mixing and loading operations, and served as the representative for and the communication link with the Command Post.

OPERATIONAL CONSIDERATIONS

Insecticide Rate and Number of Applications

Dipel 8AF, Dipel 8L, and Foray were applied during two short application periods at the rate of 16 BIU (billion international units) in 1 gallon (128 ounces) of total formulation per acre. Each of the 17,444 acres were sprayed once and 12,324 of these received a second spray one week later in order to reduce gypsy moth populations where they were the greatest threat to the forest resources. Samples of undiluted B.t., as shipped were taken at the bulk storage sites and bioassayed for biological activity by USDA, APHIS Otis Methods Improvement Center. The results of the analysis for this year's and last year's B.t. samples are shown on the following pages.

Dimilin 25W was applied at the rate of 2 oz. of wettable powder in one gallon of water per acre with no additives. Most of the 12,441 acres being treated with Dimilin were treated before B.t. spraying began.

1989 Results

Table 1. Percent mortality of 2nd instar gypsy moth larvae and seedling defoliation following exposure to red oak seedlings treated with a number of *Bacillus thuringiensis* formulations at 16 BIU/gallon/acre.

Formulation	Percent mortality			Percent defoliation		
	4 day	6 day	8 day	4 day	6 day	8 day
DIPEL 8AF 27-123	67	100		11	11	
DIPEL 8AF 27-126	50	98	100	22	22	
DIPEL 8AF 27-123 27-126	63	99	100	17	17	
DIPEL 8L 28-298	11	45	70	54	77	82
DIPEL 8L 28-305	18	67	82	38	59	85
FORAY 48B 6016	70	97	99	6	7	7
FORAY 48B 6018	66	94	99	13	13	15
FORAY 48B (LAB. STD.)	74	97	100	6	6	
DIPEL 8L (LAB. STD.)	5	52	65	58	77	
DIPEL 8AF (LAB. STD.)	56	94	98	15	22	
CONTROL	0	0	0	66	100	

Table 2. Percent mortality of 2nd instar gypsy moth larvae and seedling defoliation following exposure to red oak seedlings treated with a number of *Bacillus thuringiensis* formulations at 8 BIU/gallon/acre.

Formulation	Percent mortality			Percent defoliation		
	4 day	6 day	8 day	4 day	6 day	8 day
DIPEL 8AF 27-123	7	77	92	10	32	42
DIPEL 8AF 27-126	28	72	91	13	13	13
DIPEL 8AF 27-123 27-126	18	70	91	21	30	36
DIPEL 8L 28-298	2	3	11	18	64	
DIPEL 8L 28-305	4	5	13	22	64	
FORAY 48B 6016	47	94	100	15	17	17
FORAY 48B 6018	78	99	100	4	5	5
FORAY 48B (LAB. STD.)	61	96	99	8	12	12
DIPEL 8L (LAB. STD.)	1	7	11	74		
DIPEL 8AF (LAB. STD.)	7	71	85	52	54	
CONTROL	0	0	0	88		

Spray Block Selection

During the first application, there were 88 spray blocks of National Forest land totalling 29,806 ± 10% acres (refer to Appendix Exhibit "A"). During the second application, 47 of the same National Forest spray blocks were retreated with Dipel 8AF, Dipel 8L and Foray. All of these blocks had either high value developed recreation sites, valuable wildlife areas, or thinned high value oak timber stands threatened by gypsy moth. All spray blocks had the highest priority for treatment. Each block had its boundaries delineated on: 1) 7.5 minute quad maps; 2) color infrared aerial photographs (1:24,000 scale) taken in 1985 and 1986. Also, helium-filled balloons were used to mark the corners and reference points for as many blocks as feasible given good access and field crew logistics the morning of spraying. Many of the blocks were ballooned the night before spraying which helped to reduce the amount of ballooning before daylight.

Application Equipment

Aircraft - A DC-3, an Ayres Thrush, and a Twin Beech were used on this project, operated by K & K Spray Contractors of Virginia. Each of the aircraft was equipped with a spray distribution system designed to produce small droplets (as defined below) and distributed these droplets uniformly over a specified operational swath pattern.

The spray contract called for the contractor to maintain an average daily production quota of at least 2,000 acres per day during the Dimilin application, 4,000 acres during the first and second B.t. applications, and 2,000 acres during the single B.t. treatment. Because of an overlap in spray days for the B.t. and dimilin, an average daily production for each material cannot be determined. However, an overall production average of 4,712 acres per day was accomplished which was well above the minimum daily quotas set in the spray contract. The requirement to meet an average daily production quota is essential because of: 1) the uncertainty of inclement weather over the areas during the spray window; 2) the scattered nature of treatment areas; 3)down time from other unpredictable factors.

Spray System - Each aircraft was equipped with an approved standard spray boom system of the type most commonly employed in aerial applications of the type discussed in the following specifications:

Nozzle Specifications - All nozzles were of the flat fan type. All nozzle tips were of the same size and were new and never used brass nozzles or stainless steel nozzles with only slight use.

Spray Boom - This was capable of being rotated to allow orientation of nozzle tips either forward or backward in order to take advantage of wind shear to assist breaking up and dispersion of droplets.

Boom Pressure - Pumps were capable of producing, and entire system was capable of sustaining, pressures of 40-65 PSI.

Spray Tanks - Leakproof corrosion-resistant tanks with exterior filler openings were used. Filler openings or neck were large enough to prevent surging during filling. Tanks were vented to the outside of the fuselage.

Calibration and Characterization

On the afternoon of May 22, 1989, Forest Pest Management personnel calibrated and characterized the aircraft spray systems at the expense of the Contractor, using actual insecticide formulated as per the work plan prior to actual spray operations using standard procedures to meet the following specifications:

Droplet Size - All nozzle tips on an aircraft were of the same size and capable of producing droplet sizes of 150 microns VMD (Volume Median Diameter).

Delivery Rate - Delivery of one (1) gallon (128 oz.) per acre.

Swath Width - The swath width of the DC-3 was determined to be 300 feet while the swath width for the Thrush and the Twin Beech were 100 feet.

Spray Timing

No spraying was done within a Gypsy Moth Development Unit until it had been released by the Forest Service Project Entomologist. Release of areas for spraying depended upon insect development and tree foliage expansion within each of the Gypsy Moth Development Units considered to represent conditions throughout the three different ranger districts: A-Bradford Ranger District; B-Marienville Ranger District; C-Ridgway Ranger District. Release of the Dimilin spray blocks was made when egg hatch was estimated to be 100%. Release of the B.t. spray areas were made when foliage of the most prevalent oak species present reached one-fourth to one-third of its normal size, and the majority of gypsy moth larvae on that foliage were in the second and third instars. The actual conditions of insect development and tree foliage expansion when the blocks were released for spray on May 23 are shown below:

Table 3. Gypsy Moth Larval Development and Foliage Expansion

	Gypsy Moth Development Unit					
	A		B		C	
	Dimilin	B.t.	Dimilin	B.t.	Dimilin	B.t.
Release Date	5/23	5/30	5/22	5/30	5/22	5/30
% Egg Hatch	100	100	100	100	100	100
% 2nd/3rd Instar	0	15	0	20	0	20
% White Oak Leaf Expansion	10	30	10	30	10	30
% Red Oak Leaf Expansion	10	30	17	40	16	40
% Other Species Leaf Expansion	29	60	37	75	35	75

All blocks within a Development Unit were released simultaneously with their scheduling determined by the Forest Service's Contracting Officer's Representative (C.O.R.) in consultation with his Air Operations Advisor, and the Contractor's Project Coordinator.

The timing of gypsy moth egg hatch, larval development, and foliage development are all dependent upon the maximum and minimum temperatures which occur from the time the eggs are layed in late summer to egg hatch in late April to early May. Being able to better predict the timing of hatch and development would be a great help in planning gypsy moth suppression projects. Using daily maximum and minimum temperature collected from the Kane Experimental Forest and a pumping station in the Ridgway Ranger District from August 1, 1988 until May 1, 1989, FPM personnel predicted the hatch and development timing using GMPHEN-Gypsy Moth Phenology Model, which was developed by Dr. Katherine Sheehan, USDA Forest Service for use in life cycle analysis of the gypsy moth. Results of the prediction are shown below.

Table 4. Gypsy Moth Hatch, Larval and Foliage Development Prediction-1989

			Percent by Life Stage			
jday	month	day	eggs	1st instar	2nd instar	Leaf Expansion
131	5	11	100	0	0	0
133	5	13	100	0	0	0
135	5	15	99	1	0	.5
137	5	17	85	15	0	1.6
139	5	19	85	15	0	3.2
141	5	21	62	38	0	6.8
143	5	23	17	83	0	15.5
145	5	25	17	83	0	22.3
147	5	27	9	91	0	32.5
149	5	29	2	96	2	49.5
151	5	31	0	74	26	67.8

Initial egg hatch was predicted to occur on May 15, 1989 with the actual dates being May 9 for both the Marienville and Ridgway districts and May 13-15 for the Bradford district. Dimilin spray was planned to start as soon as 100 percent egg hatch occurred and B.t. application was to start when most of the larvae were first and second instars and the foliage expansion of the prevalent oak species on site reached 30 percent. The computer model predicted that the Dimilin and B.t. applications could start on May 31 while the actual dates were May 22 and 23 for the Dimilin application and May 30 for the B.t. application. For the most part, the predicted dates of application fell within a week of the actual dates. These predictions are not precise, however, if we can predict the dates of application ahead of time, with some degree of confidence, the planning process, as far as contacting the contractor and mobilizing field crews is concerned, will be greatly simplified. FPM personnel are planning to collect gypsy moth phenology data during the 1990 field season so that the GMPHEN model can be tested and any improvements made to help better predict gypsy moth development thus making suppression project timing and field activity coordination more efficient.

Weather Restrictions - The Forest Service's C.O.R. or in his absence his designate determined when spraying operations were prohibited. Information supplied by the field crews, the Project Weather Specialist, and an Air Operations Advisor in a monitor aircraft were used in making these decisions. The following spray area conditions were used as guidelines in halting spray operations:

Wind velocity exceeding ten (10) miles per hour at ground level.

During rain or foggy weather, or when the foliage is dripping wet, or when there is an imminent threat of rain within four hours.

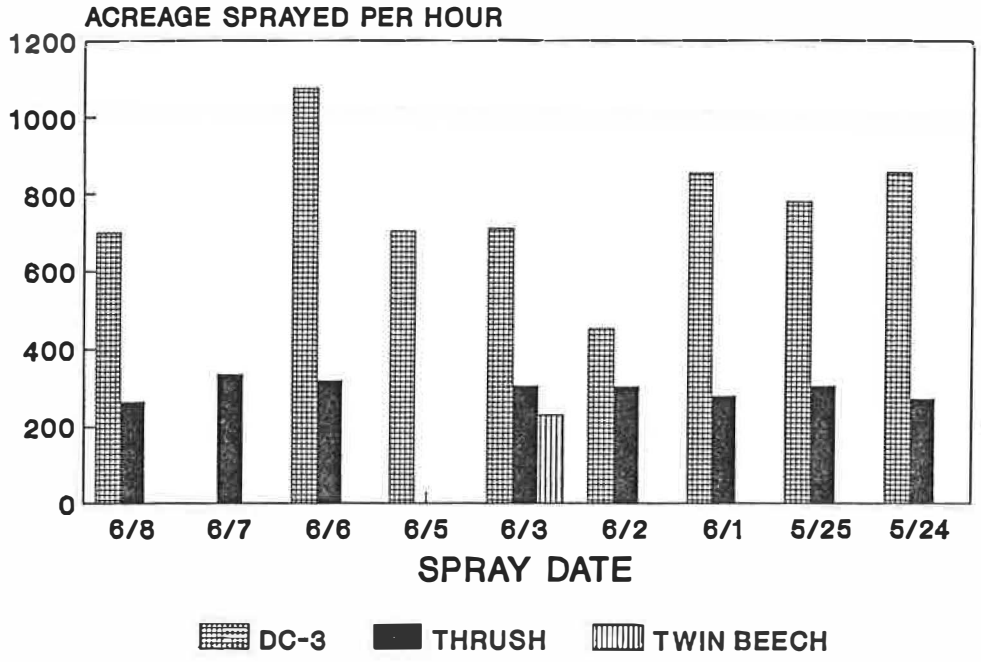
When air turbulence (thermal updrafts, etc.) is so great as to seriously affect the normal spray pattern, or causes disruption of helium-filled marking balloons. Generally, thermals do not develop until the temperature goes above 80 degrees F.

When in the opinion of the Forest Service, the spray material will not effectively reach the intended target.

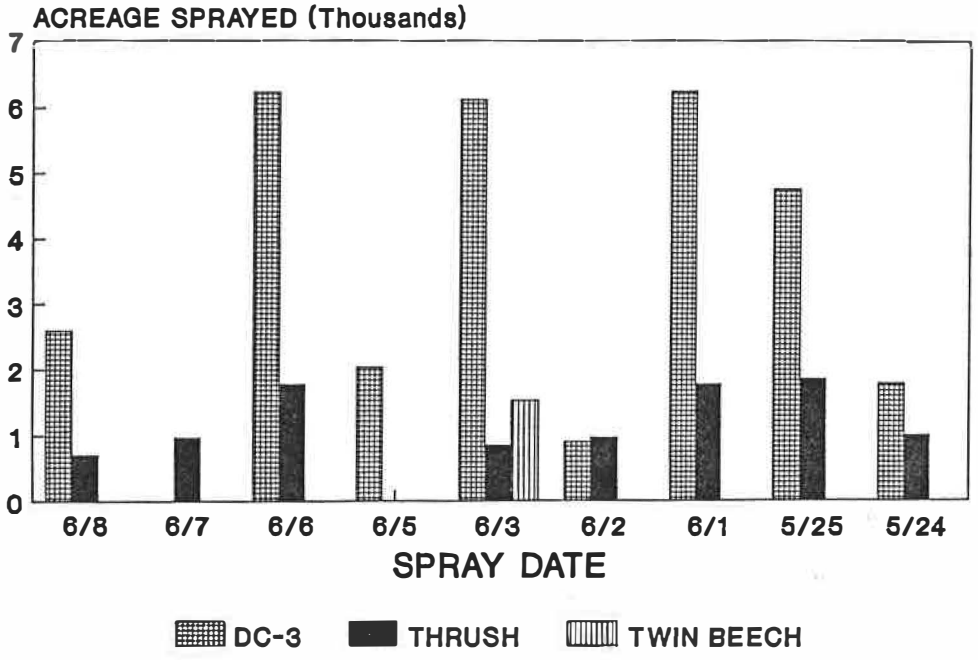
Spray Schedule and Progress- Spraying began on May 24, 1989 and continued on May 25, June 1, 2, 3, 5, 6, 7, and 8. Rain days occurred on May 23, 26, 30, and 31 and fog delayed spraying near the Clarion River several mornings. The spray record showing gallons sprayed and date completed for each airplane is presented in the Appendix. Because of an inadequacy in the data recording process, the original record showing ferry times and spray times is incomplete and cannot be used for the analysis of the daily production or hourly production of each aircraft.

The hourly production and daily production figures for each aircraft were calculated using the inspector's daily record and the flight use report filed each day. The hourly and daily production for each aircraft are shown in Graphs 1 and 2.

HOURLY SPRAY PRODUCTION BY AIRCRAFT



DAILY SPRAY PRODUCTION BY AIRCRAFT



Spray Days - The intention of the Forest Service was to spray six-days per week during the spray window whenever conditions were acceptable. To avoid pilot and support personnel fatigue, every attempt was made to have a rest day during each seven (7) day working period normally when the weather conditions were not favorable for spraying. Because of rainy weather and the practice of placing the balloons the night before spraying, fatigue did not seem to be a problem.

Application Monitoring- The actual application of insecticide was monitored both from the air, from two single engine airplanes, and from the ground. Individuals on the ground marked pre-determined block corners with helium balloons, and collected data on the conditions at the time of application. A set of field instructions that was provided to the field personnel can be referenced in the 1989 Allegheny National Forest Gypsy Moth Work Plan. All this data is included in a computerized spray monitoring data base which stores and evaluates this information for interpreting and evaluating the degree of success achieved.

During the first application (Dimilin, first B.t., and single B.t. applications),aerial monitoring covered approximately 48 blocks and 63 percent of the area sprayed. Monitoring of the second application covered 38 blocks and 77 percent of the area. From the observation records made by ground and air personnel, it seemed that the objectives of limiting the spray to the designated blocks and avoiding applications and turns over water, private property, and open areas were well achieved.

Respraying- Only one of the spray blocks (block 45) required any amount of respray. The DC-3 had made three swaths across the block when a rainstorm began. Some of the dimilin blocks received rain within minutes following spray application, however, a check of the efficacy in the block indicated that respray was not necessary.

Communications- Radios provided by the various Ranger Districts on the Allegheny National Forest and FPM were used by ground and air support personnel for coordinating the operation. K & K Aircraft Inc. provided a separate radio system for their own use during the actual spray operation. This insured that ground support communications did not interfere with the pilots while the aerial application was taking place. The district inspectors maintained a link with the spray contract personnel to provide information to ground personnel concerning changes in the spray schedule.

Pesticide Handling and Disposal- The contractor was responsible for the acquisition, handling, and disposal of all Dimilin and B.t. used in this project. All empty containers were triple rinsed and the rinse water figured into the spray mixture. The contractor was also responsible for the disposal of all empty containers.

PUBLIC INFORMATION AND NOTIFICATION

The public was notified about spray block locations, spray schedules, and spray progress by posted signs along roads bordering and entering spray blocks, press releases, and radio announcements. People occupying developed recreation sites scheduled for aerial spraying were notified within a reasonable time preceding treatment so that if they desired, they could depart without being in the area during spraying. No spraying was conducted in campgrounds on holidays or weekends.

SAFETY

The Allegheny National Forest prepared a project safety plan, which helped in the training of personnel on how to conduct themselves in a safe manner, especially in the vicinity of the spray aircraft and support equipment.

The contractor's pilots and ground support personnel operated their equipment in a safe and responsible manner and no accidents occurred.

PROJECT PROGRESS, ACCIDENT AND INCIDENT REPORTING

Daily reports were provided to the Incident Commander. A brief report on acreage treated by insecticide during the day and acreage planned for treatment the next day was made by 3 p.m. daily and forwarded to FPM, Morgantown. There were no pesticide spills or dumps reported to the Incident Commander.

One incident was reported to the Incident Commander during the project. An Allegheny National Forest employee who was part of the balloon marking crew was bitten on the forearm by a dog. The crew member was taken to a local clinic, treated and released. The bite was severe enough to disable the crew member for most of the project, however, he did fully recover and was able to return and finish the project.

PROJECT BUDGET

The estimated cost of this project totals $674,800 for Fiscal Year 1989 which was be financed through FPM, WO. The tabulations below show how this total was developed based on contracting services associated with aerial application (estimated at $512,500), field support during planning and conduct of the project by the Allegheny National Forest (estimated at $90,200) and FPM, Morgantown, technical support and monitoring (estimated at $41,000).

Table 5. SUMMARY OF ESTIMATED COSTS FOR 1989 SUPPRESSION PROJECT
ALLEGHENY NATIONAL FOREST

A. CONTRACTING SERVICES

Aerial application costs associated with purchase of Dipel 8AF, Foray, and Dimilin 25W and storage, transport, mixing/loading, fixed-wing application, cleanup on an estimated 42,412 ± 10% acres = 46,653 acres.

	Estimate	Actual	Difference
TOTAL	$512,500	$318,068	$194,432

B. TECHNICAL SUPPORT AND MONITORING BY FPM, MORGANTOWN

Item	Project Cost	Actual Cost	Difference
I. Personnel			
Temporary	$ 25,000	$ 20,746	$ 4,254
II. Per Diem			
Temporary	$ 4,000	$ 7,953	$-3,953
Permanent	8,400	7,309	1,091
Subtotal	12,400	15,262	-2,862
III. Overtime			
Temporary	7,000	4,844	2,156
Permanent	3,000	3,309	- 93
SUBTOTAL	10,000	8,153	2,063
V. Vehicles	7,700	7,700	0
V. Services			
Aerial Photography (NASA)	20,000	20,000	0
(SPOT)	8,000	7,800	- 200
VI. Equipment & Supplies	3 000	5,822	-2,822
TOTAL	$86,100	85,267	833
C. ALLEGHENY NF			
EA Preparation, Contract	$76,200	123,771	-47,500
Administration and Project Support			
GRAND TOTAL	$674,800	527,106	147,694

Post-treatment Evaluation

Spray Operation- Overall, the spray operation went very smoothly. The only delays in the spray operation were minor and occurred when mechanical failure of the vehicles or a change in the spray block order delayed ground personnel in placing the balloons. Ground support personnel worked very long hours, often from 4 a.m. to 9 or 10 p.m. However, breaks were taken when spray was halted and fatigue did not seem to become a factor.

Data Collection- Pre-spray, spray, and post spray monitoring data was collected in all of the 88 spray blocks. This information was used to evaluate the project effectiveness in the following categories:

Achievement of Project Objectives- The objective to prevent moderate to severe defoliation was accomplished in all 88 of the spray blocks, while the secondary objective to reduce egg mass densities by at least 90 percent was accomplished in all but 5 of the spray blocks. The acreage represented by the 83 successfully treated blocks is 27,492 acres or 92 percent of the treated area. For the remainder of this report, the success of a spray block will refer specifically to the population reduction results for each of the spray blocks. This is due to the fact that all of the blocks were successfully treated when considering defoliation prevention.

Pre-Treatment Populations- Population densities based on a limited number of plots measured before treatment averaged 772 egg masses per acre and ranged from 33 to 6100 for all of the spray blocks. Spray blocks in which the egg mass densities were reduced by 90 percent or more had average pre-spray counts of 788 per acre and ranged from 33 to 6100 while the unsuccessful blocks averaged only 509 per acre and ranged from 155 to 937. These results are different from what would generally be expected and seem to indicate that some other variable(s) were responsible for the success or failure of the spray.

While the population reductions within the treated areas look favorable, populations in adjacent, untreated areas also declined. In several cases, the untreated areas experienced population reductions as great as in the treated areas. Table 6 shows a comparison of pre and post-treatment egg mass densities and the resulting increase or decline in population within the Opportunity Areas containing spray blocks.

Table 6. Allegheny National Forest, 1989 Gypsy Moth Suppression. Population Changes in Treated and Untreated Areas.

Opportunity Area (Untreated)/ Spray Blocks	Number of Plots	Pre-Treatment EM/acre	Post-Treatment EM/acre	% Change
B2M	19	304	22	-93
1-3,5,6,11,12,15,16	57	633	19	-97
B7L	6	90	32	-64
17,18	18	605	64	-89
B3M	60	120	39	-68
4,7-10,13-15,19,20	71	660	37	-94
M4H	12	207	25	-88
31,32	12	237	0	-100
M10M	11	1230	28	-98
48,52-58	48	146	0	-100
M11M	9	1187	35	-97
21,22,26,28,33-38, 41-44,46,47,49-51	108	420	1	-99
*M12M	5	915	35	-96
23-25,27,29,30 38-40,45,60-68	114	655	7	-99
**M12M	5	2051	23	-99
73-75,77-91	120	1640	6	-99
R11M	20	1327	19	-99
72,76	15	1803	0	-100

* The part of Opportunity Area M12M which is within the Marienville District.

** The part of Opportunity Area M12M which is within the Ridgway District.

Population Health- From the 1988-1989 Biological Evaluation of the Gypsy Moth on the Allegheny National Forest, it is shown that gypsy moth populations were declining throughout most of the Allegheny National Forest. The 5 spray blocks which were unsuccessfully treated with respect to egg mass density reduction all were within Opportunity Areas that had increasing gypsy moth population trends. These results are not surprising, however, there were also spray blocks within other Opportunity Areas with increasing population densities which were successfully treated. Another factor that is used when trying to determine the overall health of a gypsy moth population is egg mass size. The average egg mass size within the Opportunity Areas with unsuccessful spray blocks was medium to large (nickel to quarter). There were also successfully treated blocks within areas with medium to large egg masses, however, there were no unsuccessful blocks within areas in which the egg masses were small.

Egg mass viability was also used to evaluate the health of the gypsy moth populations on the Allegheny National Forest. Ten egg masses were collected from 5 sites throughout the 3 districts on which spraying took place. The masses were analyzed for the number of eggs per mass and the percent of eggs parasitized, hatched, and viable. The results of this analysis are shown below.

Table 7. Gypsy Moth Egg Mass Evaluation Results

Area	Average Eggs/mass	Percent Parasitized	Percent Non Parasitized	% Hatch	Percent Viable	% Non Viable
Site 1. Marienville	284	33	67	65*	44**	23
Site 2. Ridgway	440	40	60	56*	34**	26
Site 3. Bradford	442	5	95	65*	61**	34
Site 4. Bradford	298	33	67	77*	52**	15
Site 5. Ridgway	312	34	66	35*	23**	43

* Percent hatch represented by only non-parasitzed fraction of eggs.

** Percent viable calculated using total eggs/mass (parasitized, viable, and non-viable).

As can be seen from the table, Site 3 in Bradford has the highest average number of eggs per mass, the lowest level of parasitism, and the highest level of viability. This Site also coincides with the area containing the 5 spray blocks in which the desired population reduction was not achieved.

These results indicate that the overall health of the gypsy moth population certainly plays a major role in the level of effectiveness that is achieved following the spray application.

Number of Treatments- Forty-five of the 88 spray blocks were treated twice with one of the three B.t. formulations used on the project. All of the double application blocks were treated successfully with respect to both defoliation protection and egg mass reduction. All of the Dimilin treated blocks and 7 of the 12 single B.t. application blocks were also successful in meeting the defoliation and population objectives. The 5 remaining single application blocks were successfully protected against defoliation but the population reduction was less than anticipated. These results suggest that when deciding on the number of B.t. applications, if the chance of moderate to severe defoliation exists, and it is economically feasible, it is better to procede with 2 applications.

Type of Insecticide- As stated in the previous section, all of the Dimilin blocks were successfully treated for both defoliation protection and population reduction, all of the double B.t. applications were equally successful, and 7 out of 12 of the single B.t. applications were totally successful.

Larval and Foliage Development- All three of the Gypsy Moth Development Units were released at approximately the same time and the development of the larvae and foliage were such that there were no differences in the success of the blocks due to larval and foliage development.

Application Conditions- No obvious differences were noticed in the time of day, weather conditions, or spray applicator that would help in determining the success or failure of any given spray block.

Bioassay of B.t.- In all cases, the samples from the project gave results which were equal to or better than the laboratory standards that they were tested against.

Post-Treatment Evaluation Summary

As we can see from the post-treatment evaluation sections, several different factors probably contributed to the success or failure of all of the sprayed areas. Within the successfully treated blocks, (in terms of defoliation protection and population reduction), the combination of a collapsing population, a cold wet spring, Dimilin and double B.t. applications, as well as a very competent group of FPM, ANF, and contracting personnel all were responsible for the total treatment success. As for the five blocks in which we were not successful in achieving the expected level of population reduction, the healthier, more vigorous populations, coupled with only a single B.t. application, may have caused the reduction in spray effectiveness. Nevertheless, the overall project, considering the large acreage to be sprayed and the shortened biowindow due to bad weather, would have to be considered a great success.

Water Quality and Macroinvertebrate Sampling Results

During the 1989 Allegheny National Forest gypsy moth spray project, approximately 12,441 acres of oak forest type were treated with Dimilin. Dimilin was used because of its increased effectiveness against high density gypsy moth populations compared to the efficacy of the B.t. products. Because of concerns expressed about the non-target effects on stream macroinvertebrate populations, which make up the bulk of the native trouts' diet, a two-phased water quality/macroinvertebrate sampling plan was designed and implemented by Allegheny National Forest, FPM, and Trout Unlimited personnel.

The objectives of this plan were to detect the migration of Dimilin in surface water and to determine the effects (if any) of spraying near macroinvertebrate populations.

The following are excerpts from preliminary reports written by ANF personnel:

MACROINVERTEBRATE RESULTS FROM FY 89 DIMILIN MONITORING

I have received the macroinvertebrate data from the Corp.. Diversity and Productivity declined at all stations with Nelse Run having the most drastic decline. The Corp. is processing the samples further to allow a comparison of wet and dry weights and will be plugging the data into their ADP system to compute diversity indices. In the meantime I will be working with Brent to break the data down further by individual taxa and functional class to see if there are any detectable differences in the effects to intolerant vs. tolerant species. I will also try to correlate effects of the above average rainfall that occurred during the sampling period (4/19-6/28), as much of this decline could be attributed to the severe flooding and scouring that many of these streams received in May and June between the pre and post spray samples. Below is a cursory summary of the data for your information:

Stream Name	Treatment	%Change in # of taxa	%Change in # of organisms
Bradford R.D.			
Brothwell Run	Dimilin	-13.3	-29.3
Hemlock Run	Bt	-57.2	-80.3
Nelse Run	Dimilin	-91.8	-99.0
Pigeon Run	Control	-15.0	-52.9
Coffey Run	Dimilin	-13.8	-79.0
Morrison Run	Bt	-51.0	-61.6
Ridgeway R.D.			
Little Bear Cr.	Control	-54.8	-77.0
Gillis Run	Dimilin	-56.2	-90.8

Because of the decline in all control and treatment categories, it is suspected that the extreme amounts of rain and subsequent high water conditions experienced during the time of application is the major factor affecting the stream macroinvertebrate populations. Further testing will be conducted however, and the results presented when the become available.

Sampling Results for Water Quality
Monitoring in Support of
FY 89 Gypsy Moth Suppression

Monitoring Station	Sampling Intensity			
	Pre-Spray	Time of Concentration	24 hr.	1st Rain
B-1 Nelse Run	5-10-89	6-03-89	6-04-89	6-04-89
*Block 6,sw Block 2 finished 6/3 16:40	09:30 ND	18:00 ND	08:00 ND	17:00 ND
B-2 Coffey Run	5-10-89	6-03-89	6-04-89	6-04-89
Block 1 finished 6/3 14:53	11:30 ND	17:30 ND	08:00 ND	17:00 ND
B-3 Brothwell Run	5-10-89	6-03-89	6-04-89	6-04-89
	10:00 0.1 ppb	16:30 ND	08:00 ND	17:00 ND
B-4 Pigeon Run	5-10-89	6-03-89	6-04-89	6-04-89
CONTROL	10:00 ND	16:55 ND	08:00 ND	17:00 ND
R-1 Little Bear Cr.	4-23-89	5-25-89	5-26-89	5-26-89
CONTROL	13:00 ND	11:05 ND	10:10 ND	10:10 ND
R-2 Gillis Run #1	5-10-89	5-24-89	5-25-89	5-26-89
	10:30 ND	21:45 ND	19:20 ND	08:45 ND
R-2 Gillis Run #2	5-10-89	5-25-89	5-26-89	5-26-89
	10:30 ND	09:15 ND	08:45 ND	08:45 ND

ND = None Detected

1/ As a precondition to collecting this sample, rainfall had to equal or exceed 0.25 inch in a 24-hour period, and must be received within 4 weeks of treatment.

VI. CONCLUSIONS

a) No detectable levels of diflubenzuron were present before treatment in streams or seeps adjacent to spray sites B-1, B-2, B-4, R-1, or R-2. This conclusion is based on pre-spray sample results indicating no diflubenzuron was present.

b) Diflubenzuron was detected in the pre-spray sample at Brothwell Run at a concentration of 0.1 part per billion (ppb). The level of concentration of diflubenzuron in Brothwell Run, site B-3, was less than the lowest level of detection specified in the laboratory contract (0.5 ppb). Detection of the product in surface water is usually attributed to saturated soil conditions/ overland runoff transport from the spray block to receiving stream, or drift from the application area. Lab error in sample ID date & time is the probable cause for a pre-spray sample result. Drift card results from Brothwell Run indicate ---------- to support this conclusion.

c) No insecticide contamination of water from direct spray, drift, or post spray surface or subsurface runoff was detected in stream or seeps adjacent to spray blocks B-1, B-2, B-4, R-1, or R-2. This conclusion is based on post spray sample results indicating no diflubenzuron was detected.

c) Fixed-wing aerial application controls (as specified in the Environmental Assessment and in the application contract) during 1989 were generally adequate to prevent introduction of diflubenzuron to monitored surface waters. The fact that monitored sites were the most sensitive in the application program and that stringent controls were applied to all treatments regardless of sensitivity, provides evidence that streams and seeps in the Forest were protected from the introduction of diflubenzuron as a result of aerial broadcast application.

VII. RECOMMENDATIONS

a) All application controls used for water resource protection in the FY 90 aerial application program should remain in effect for future programs. Controls are applied as identified in the contract, Environmental Assessment, and Forest Plan standards and guidelines.

b) Minimum buffer zone widths for use in the FY 90 program along streams and seeps should be retained as recommended in the 1989 Water Monitoring Report: A minimum of 300 YARDS from perennial streams or intermittent streams that have flowing water on day of spraying, and 300 YARDS from springs or seeps flowing water on day of spraying.

c) Pre-spray site specific field review of sensitive spray sites by Districts- blocks in close proximity to streams or seeps should continue to a routine part of contract inspection and administration: Identify proximity of treatment areas to lakes, streams, seeps, or wetlands. Evaluate downstream uses of waters most susceptible to contamination in the event of insecticide spills, misapplication, or drift. Especially the proximity to municipal water supplies.

PROJECT CRITIQUE

Field Crew Comments

The 1989 Allegheny National Forest gypsy moth spray project seems to have been a success. Between time limitations, the total acreage sprayed, and the cold wet weather, the spray operation went pretty smooth. The following are both the positive and negative aspects of the project as expressed by the FPM and ANF field personnel.

Positive Project Aspects

Topping the list of positive comments by field crew members was the overall fluidness of the operation after spraying finally started. This stems from the fact that all phases of the project and all those who were involved in the project knew what their jobs were and what was expected of them. Second on the list of positive comments was that both FPM and ANF personal were professional in the way that they conducted themselves and the project, and that the FPM and ANF personnel worked very well together. Third, field crew personnel felt that the provided housing was adequate in both location and function. Fourth, the fact that there was a central location to meet and store equipment made keeping track of equipment and handing out assignments much more convenient. Finally, field personnel felt that there were an adequate number of field crews and that the equipment was sufficient to get the job done.

Negative Project Aspects

Along with the positives there are always negatives, or things that could use improvement during the next spray project. First and foremost (and something that we can do nothing about) was the bad weather. Rain, fog, and wind all played a part in delaying the start and completion of the 1989 project. All we can do in the future is to be ready to take advantage of breaks in the weather and to spray when possible. Second on the list of things to be improved was the changing of the spray order at the last minute. This not only causes confusion with crew assignments, but also reduces the safety factor because crews are being dispatched to the new spray blocks in a hurry. In the future, I think that although changes cannot be fully avoided, every effort should be made to keep the planned spray block order or at least be resigned to the fact that the spray operation may be delayed until a field crew can proceed to the block in a safe manner. Third on the list is that those people at the command center and at the airport need to stick with their decisions, even if it means a delay in spray progress. This specifically refers to a situation resulting from a decision which was made to wait until morning to launch balloons and assess the weather conditions only to call field crews out at 3 am.

This type of situation also occurred when district personnel were sent home due to expected bad weather and the FPM crews wound up working understaffed all day. Decisions such as this not only affected the overall efficiency of the operation, but more importantly compromised the safety of the field personnel. Last on the list of negatives was communication, both poor equipment and too much unneccessary talking on the radio. This seems to be a problem every year and although it is still a concern, communication problems seemed to decrease as compared to past projects. Mobile radios in ANF vehicles helped field coordinators and field crews to communicate more effectively than in past projects where they only had hand held King units. Unfortunately, not every crew or coordinator's vechicle was equipped with the mobile unit. This should be a priority during the next project. The second communication problem (unnecesary talk on the radios) has been considered before and I'm not sure that anything can be done about it. Personally, I think it is important that field crews keep in touch and know where each is located in case of emergency or equipment failure. A final negative aspect, which also deals with communication, is that of poor or sometime nonexistent communication between the airport and the operations center. This is critical so that field personnel can be kept abreast of spray order and progress so that they don't fall behind and operations are not delayed. This might be alleviated by using a direct phone line between the airport and the command center instead of relying on mobile radio communication over an extended distance. This might also be solved by moving the command center closer to the airport if the phone line is not a feasible alternative.

Because of the pride and dedication brought to the project by both FPM and ANF field personnel, the positive aspects far outweighed the negatives and a very successful spray project was completed in 1989.

Supervisor Office Project Critique

On June 29, 1989, FPM and ANF personnel involved in the spray operation conducted a review and critique of the spray project. The following are lists of "what worked" and "needs improvement" that were discussed by those attending the meeting.

"What Worked"

1. Monitoring and Evaluation

   -High altitude photos
   -Ground surveys
   -Field checking larval mortality in Dimilin spray areas 1 week after rain to check on need for respray
   -Evaluate effectiveness of spraying: visual check, caterpillar mortality, defoliation, sprayed and unsprayed area check
   -Larval and foliage development survey to predict spray timing.

2. Egg Mass Survey and Biological Evaluation

3. Environmental Analysis

   -Water sampling - good first time effort

4. Contract Preparation

5. Project Implementation

-Increased aerial surveillance
-Safety plan worked
-Communications much better
-Balloons - helped to put up afternoon before
-Operations at one location
-OJT for Huron-Manistee

"Needs Improvement"

1. Monitoring and Evaluation

   -Present defoliation information in format useable in OA analysis
   -Ground check photo interpretation and VMIS stand history

2. Egg Mass Survey and Biological Evaluation

-Start end of August - Finish earlier (survey results typically Oct 1)
-Drop treatment alternatives

3. EA

-Delineate spray blocks early and Districts specify site specific concerns for each - display in EA
-Earlier EA completion date
-Design block shape for flying with aircraft - fixed wing or helicopter
-ID team members: K.Riddle and D. Clymer
-Design flyable blocks beginning of EA
-Skunk team meet in summer to evaluate and structure EA - August
-Identify ID team this summer
-Sample streams further downstream
-Dimilin block boundaries:
  use leaf-off photos
  Jack Hill review
  involve district people familiar with area
-Water sampling:
  purchase or borrow equipment if expect to do this regularly
  revisit objectives for future years
  develop along with EA rather than after EA

4. Contract Preparation

-Do multiple year "requirements" contract this fall
-Wind speed requirement - write using a range of conditions - take from a location representative of the site
-Copy of the contract to FPM
-Negotiated vs. low bidder - Discuss with Acciavatti and McHenry
-Update aircraft specs.
-Pesticides: specify manufacturer or not?

5. Project Implementation

-problem with low level military aircraft - need to achieve greater committment from the military
-Communication: telephone at the airport, try cellular phones
-Order more balloons
-Short notice spray notification is a problem when the crew is not prepared
-Minimize spray blocks order changes
-Check with field crews to determine effects of changing spray block order.

The information from the field crew critique as well as the Supervisor's Office critique will be used in the 10 Year Gypsy Moth IPM Plan that will be completed during FY 90.

APPENDIX

MAPS OF SPRAY BLOCK LOCATIONS

SPRAY BLOCK LIST

Table 8. 1989 GYPSY MOTH SPRAY BLOCKS, ALLEGHENY NATIONAL FOREST

	DEV UNIT	ACRES	RESOURCE AT RISK	DEFOLIATION POTENTIAL	INSECTICIDE	ENTO AREA	MGT AREA	QUAD NAME	DATE SPRAYED 1st	2nd
1	A	125	Wildlife	Moderate	Dimilin	B-7	6.1	Corn. Run	6/5	
2	A	1847	Wildlife/ Timber	Moderate	Dimilin/	B-7	6.1	Stickney Corn. Run	6/3	
3	A	330	Wildlife/ Timber	Moderate	Bt*	B-7	6.1	Stickney	6/3	6\8
4	A	334	Dev. Rec.	Moderate	Bt	B-7	6.4	Stickney Corn. Run	6/2	
5	A	352	Wildlife	Moderate	Bt*	B-7	6.1	Stickney	6/3	6\8
6	A	355	Wildlife	Moderate	Dimilin	B-7	6.1	Corn. Run/ Stickney	6/3	
7	A	1020	Dis. Rec.	Moderate	Bt	B-1	6.4	Corn. Run	6/5	
8	A	287	Dev. Rec.	Moderate	Bt	B-1	6.4	Corn. Run	6/2	
9	A	361	Wildlife	Moderate	Dimilin	B-6	6.1	Corn. Run Corn. Bdg	6/2	
10	A	149	Dev. Rec	Moderate	Bt	B-6	6.1	Corn. Bdg.	6/2	
11	A	283	Wildlife	Moderate	Bt	B-6	6.1	Corn. Bdg.	6/3	
12	A	334	Visual	Moderate	Dimilin	B-6	6.1	Corn. Bdg.	6/3	
13	A	862	Wildlife	Moderate	Bt	B-6	6.1	Corn. Bdg.	6/3	
14	A	119	Visual	Moderate	Bt	B-6	6.1	Corn. Bdg.	6/3	
15	A	870	Dev. Rec. Visual	Moderate	Bt*	B-3	6.1 7.0	Corn. Bdg.	6/3	6\6

Table 8. (continued)

BLOCK #		ACRES	RESOURCE AT RISK	DEFOLIATION POTENTIAL	INSECTICIDE	ENTO AREA	MGT AREA	QUAD NAME	DATE SPRAYED 1st	2nd
16	A	271	Timber	Moderate	Bt	B-3 B-6	6.2 6.1	Corn. Bdg.	6/3	
17	A	990	Timber	Moderate	Bt	B-3 B-6	6.1 6.2	Corn. Bdg. West.ine	6/3	
18	A	161	Visual	Moderate	Bt	B-6 B-12 B-3	3.0 6.1 6.2	Corn Bdg. Westline	6/3	
19	A	511	Dev. Rec. Timber	Moderate	Bt	B-4	6.1	Corn. Bdg.	6/3	
20	A	133	Dev. Rec.	Moderate	Bt	B-3	6.1	Corn. Bdg.	6/2	
21	B	67	Timber	Moderate	Bt*	M-8	3.0	Hallton-29	6/2	6\7
22	B	128	Timber	Moderate	Dimilin	M-8	3.0	Hallton-29	5/24	
23	B	202	Timber	Moderate	Dimilin	M-8	6.1	Hallton-29	5/24	
24	B	42	Visual	Moderate	Bt*	M-8	6.1	Hallton-29	6/2	6\7
,	B	681	Timber	Moderate	Bt*	M-8	6.1	Hallton-29	6/3	6\8
26	B	284	Timber	Moderate	Dimilin	M-8	6.1	Hallton-29	5/24	
27	B	147	Visual	Moderate	Bt*	M-8	6.1	Munderf-33 Hallton-29	6/3	6\8
28	B	38	Timber	Moderate	Dimilin	M-8	3.0	Hallton-29	5/24	
29	B	260	Timber	Moderate	Bt*	M-8	6.1	Munderf-33 Hallton-29	6/3	6\8
30	B	113	Visual	Moderate	Bt*	M-8	6.1	Munderf-33 Hallton-29	6/2	6\8
31	B	1037	Timber	Moderate/ Severe	Dimilin	M-6	3.0/6.2	Kelletville Mayburg-	5/25	
32	B	213	Timber	Moderate	Bt*	M-6	3.0/6.2	Mayburg	6/3	6\8
33	B	120	TImber	Moderate	Bt*	M-8	3.0	M'ville East	6/1	6\5
34	B	82	Wildlife	Moderate	Dimilin	M-8	3.0	M'ville East	5/24	

Table 8. (continued)

BLOCK #		ACRES	RESOURCE AT RISK	DEFOLIATION POTENTIAL	INSECTICIDE	ENTO AREA	MGT AREA	QUAD NAME	DATE SPRAYED 1st	DATE SPRAYED 2nd
35	B	73	Wildlife	Moderate	Bt*	M-8	6.1	M'ville East	6/1	6\5
36	B	215	Wildlife	Moderate	Bt*	M-11	3.0	M'ville East	6/1	6\5
37	B	273	Wildlife	Moderate/ Severe	Dimilin	M-11	3.0	M'ville East	5/25	
38	B	234	Timber	Moderate/ Severe	Dimilin	M-11	3.0	M'ville East Sigel	5/25	
39	B	313	Timber	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6\5
40	B	548	Timber	Moderate/ Severe	Dimilin	M-11	3.0	M'ville East	5/25	
41	B	178	Timber	Moderate/ Severe	Dimilin	M-11	3.0	M'ville East	5/25	
42	B	172	TImber	Moderate/ Severe	Dimilin	M-11	1.0	M'ville East	6/1	
43	B	216	Timber	Moderate/ Severe	Bt*	M-11	1.0	M'ville East	6/1	6\5
44	B	238	Timber	Moderate/ Severe	Dimilin	M-11	6.1	M'ville East	5/25	
45	B	448	Timber	Moderate Severe	Bt*	M-11	3.0	M'ville East Sigel	6/3	6\8
46	B	38	Wildlife	Moderate/ Severe	Bt*	M-11	1.0	M'ville East	6/1	6\5
47	B	28	Wildlife	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6\5
48	B	501	Wildlife	Moderate/ Severe	Dimilin	M-11	1.0	M'ville East	5/25	
49	B	382	Wildlife	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6\5
50	B	449	Wildlife	Moderate Severe	Bt*	M-11	3.0	M'ville East	6/1	6/5
51	B	15	Wildlife	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6/6

Table 8. (continued)

BLOCK #		ACRES	RESOURCE AT RISK	DEFOLIATION POTENTIAL	INSECTICIDE	ENTO AREA	MGT AREA	QUAD NAME	DATE SPRAYED 1st	DATE SPRAYED 2nd
	B	149	Wildlife	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6/6
53	B	23	Wildlife	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6/6
54	B	1166	Wildlife	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6/6
55	B	242	Wildlife	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6/6
56	B	402	Wildlife	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6/6
57	B	555	Wildlife	Moderate/ Severe	Bt*	M-11	6.3	M'ville East	6/1	6/6
58	B	402	Wildlife	Moderate/ Severe	Bt*	M-11	6.1	M'ville East	6/1	6/6
59	B	170	Wildlife	Moderate/ Severe	Bt*	M-11	3.0	M'ville East	6/1	6/6
	B	40	Wildlife	Moderate/ Severe	Bt*	M-7	6.1	Sigel	6/1	6/6
61	B	48	Timber	Moderate/ Severe	Dimilin	M-7	6.1	Sigel	5/25	
62	B	308	Timber	Moderate/ Severe	Dimilin	M-7	3.0	Sigel	5/25	
63	B	48	Timber	Moderate/ Severe	Bt*	M-7	6.1	Sigel	6/1	6/6
64	B	67	Timber	Moderate/ Severe	Dimilin	M-7	6.1	Sigel	5/25	
65	B	137	Timber	Moderate/ Severe	Dimilin	M-7	6.1	Sigel	5/25	
66	B	102	Timber	Moderate/ Severe	Bt*	M-7	6.1	Sigel	6/1	6/6
67	B	229	Visual	Moderate/ Severe	Bt*	M-7	6.1	Sigel	6/1	6/6

Table 8. (continued)

BLOCK #		ACRES	RESOURCE AT RISK	DEFOLIATION POTENTIAL	INSECTICIDE	ENTO AREA	MGT AREA	QUAD NAME	DATE SPRAYED 1st	2nd
68	B	467	Timber	Moderate/ Severe	Bt*	M-7	6.1	Sigel	6/2	6/7
72	C	600	Timber	Moderate	Dimilin	R-3	6.1	Hallton	5/25	
73	C	162	Visual	Moderate	Bt*	R-3	6.1	Hallton	6/2	6/7
74	C	701	Timber	Moderate	Dimilin	R-3	6.1	Hallton	5/25	
75	C	120	Visual	Moderate	Bt*	R-3	3.0	Hallton	6/2	6/7
76	C	168	Timber	Moderate	Dimilin	R-3	3.0	Hallton	5/24	
77	C	20	Visual	Moderate	Dimilin	R-2	3.0	Hallton	6/2	
78	C	96	Timber	Moderate	Dimilin	R-2	1.0	Hallton	5/24	
79	C	342	Wildlife	Moderate	Dimilin	R-2	6.1	Hallton	5/25	
80	C	309	Visual	Moderate	Bt*	R-2	6.1	Hallton	6/1	6/7
81	C	201	Visual	Moderate	Bt*	R-2	6.1	Hallton	6/1	6/6
82	C	874	Timber	Moderate	Dimilin	R-2	6.1	Hallton	5/25	
83	C	78	Wildlife	Moderate	Bt*	R-2	6.1	Hallton	6/1	6/7
84	C	368	Timber	Moderate	Bt*	R-2	6.1	P'land Mills	6/1	6/6
85	C	163	Visual	Severe	Bt*	R-1	6.1	P'land Mills	6/1	6/6
86	C	2167	Timber	Severe	Dimilin	R-1	6.1	P'land Mills	5/25	
87	C	572	Visual	Severe	Bt*	R-1	6.1	P'land Mills Carman	6/1	6/6
88	C	348	Wildlife	Severe	Bt*	R-1	6.1	P'land Mills	6/1	6/6

Table 8. (continued)

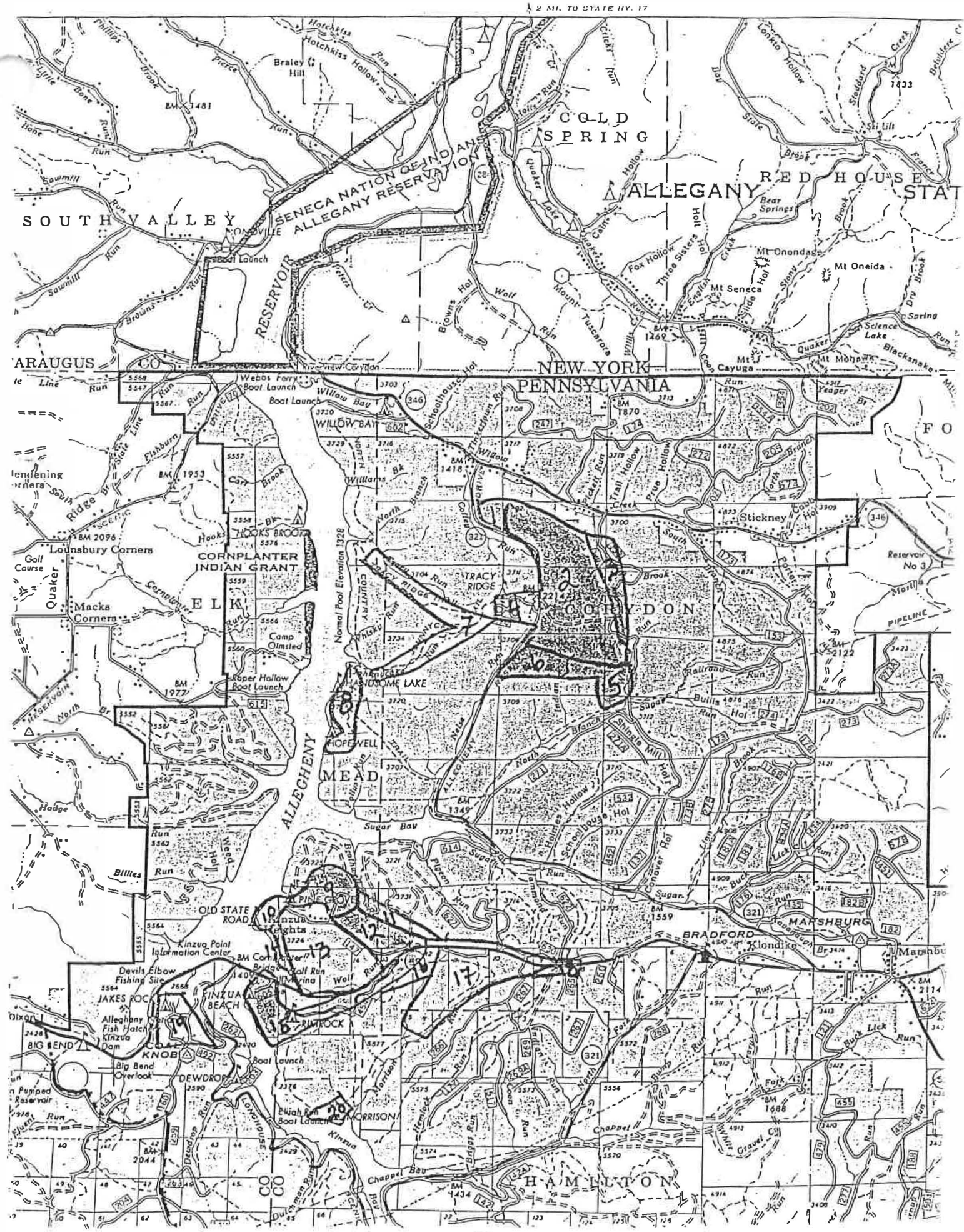
BLOCK #		ACRES	RESOURCE AT RISK	DEPOLIATION POTENTIAL	INSECTICIDE	ENTO AREA	MGT AREA	QUAD	DATE SPRAYED 1st	2nd
89	C	80	Wildlife	Severe	Bt*	R-1	6.1	P'land Mills	6/1	6/7
90	C	335	Timber	Severe	Dimilin	R-1	6.1	P'land Mills	5/24	
91	C	164	Visual	Severe	Bt*	R-1	3.0	P'land Mills	6/1	6/6

*Two Application of Bt.

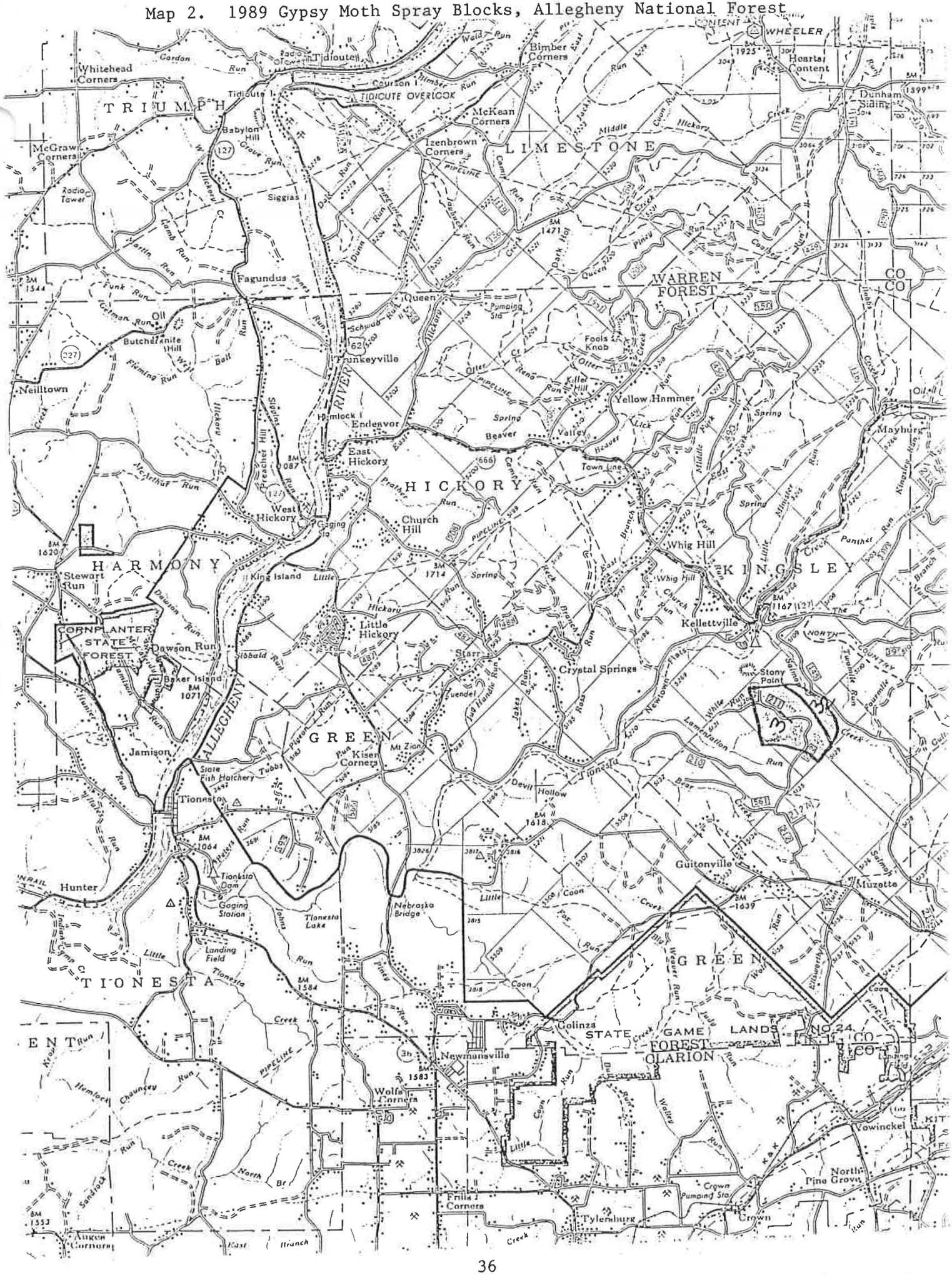
TREATMENT SUMMARY

	Bt.	Dimilin
AREA TREATED (w/both materials)	17,444	12,441
2ND Bt ACRES	12,324	
TOTAL ACRES SPRAYED (Includes 2ND Bt Spray) (w/both materials)	29,768	12,441
GRAND TOTAL	42,209	

Map 1. 1989 Gypsy Moth Spray Blocks, Allegheny National Forest



Map 2. 1989 Gypsy Moth Spray Blocks, Allegheny National Forest



Map 3. 1989 Gypsy Moth Spray Blocks, Allegheny National Forest